CLAIMS

We claim:

1. A stimulation electrode comprising an electrically conducting electrode base member partially covered with an electrically insulating ceramic layer, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is formed of an oxide and/or an oxynitride of at least one metal selected from the group consisting of titanium, niobium. tantalum, zirconium, aluminum, and silicon, and wherein the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) is further at least partially coated with an electrically conducting layer (4b, 4c, 4d, 4e, 4f, 4g) comprising at least one material selected from the group consisting of titanium nitride, niobium nitride, tantalum nitride, zirconium nitride, aluminum nitride, silicon nitride, vanadium nitride, iridium oxide, and an alloy of platinum and iridium, wherein the iridium portion of the alloy is ≥ 21 wt. % and the platinum portion of the alloy is ≥ about 100 ppm.

2. The stimulation electrode according to claim 1, wherein the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) is formed of at least one metal selected from the group consisting of titanium, tantalum, gold, carbon, platinum, iridium, platinum-iridium alloys, alloys based on cobalt and/or nickel, and stainless steel.

3. The stimulation electrode according to claim 1, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is arranged on the electrically conducting layer (4c).

4. The stimulation electrode according to claim 1, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is arranged adjacent the electrically conducting layer on the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g).

5. The stimulation electrode according to claim 1, wherein the electrically conducting layer (4b, 4d, 4e, 4f, 4g) is formed of titanium nitride.

6. The stimulation electrode according to claim 5, wherein the electrically conducting layer (4b, 4d, 4e, 4f, 4g) of titanium nitride is at least partially covered with at least one oxidation protection layer (5d, 5e, 5f, 5g) on its side facing away from the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g).

7. The stimulation electrode according to claim 6, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is arranged on the at least one oxidation protection layer (5d, 5e, 5f, 5g).

8. The stimulation electrode according to claim 6, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is arranged adjacent the electrically conducting layer (4d, 4e, 4f, 4g) of titanium

nitride and the at least one oxidation protection layer (5d, 5e, 5f, 5g) on the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g).

9. The stimulation electrode according to claim 6, wherein the ceramic layer (3,3a, 3b, 3c, 3d, 3e, 3f, 3g) is arranged adjacent the at least one oxidation protection layer (5d, 5e, 5f, 5g)on the electrically conducting layer (4b, 4d, 4e, 4f, 4g) of titanium nitride.

10. The stimulation electrode according to claim 6, wherein the oxidation protection layer (5d, 5e, 5f, 5g) is formed of at least one element selected from the group consisting of platinum, iridium, and gold.

11. The stimulation electrode according to claim 6, wherein the oxidation protection layer (5d, 5e, 5f, 5g) is formed of at least one compound selected from the group consisting of oxides, carbides, nitrides, and polymers, and wherein the at least one oxidation protection layer (5d, 5e, 5f, 5g) reduces the impedance of the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) coated with the electrically conducting layer (4d, 4e, 4f, 4g) of titanium nitride, or at most increases the impedance to a value which is smaller than the impedance of the uncoated electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g).

12. The stimulation electrode according to claim 6, wherein the oxidation protection layer (5d, 5e, 5f, 5g) has a thickness in a range of about 500 nm to about 5 μm.

13. The stimulation electrode according to claim 1, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) has a thickness in a range of about 1 nm to about 20 μm.

14. The stimulation electrode according to claim 1, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) has a surface closed in itself.

15. The stimulation electrode according to claim 1, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) has plurality of independent surfaces.

16. A method for producing a stimulation electrode according to claim 1, wherein the ceramic layer is formed by a method selected from the group consisting of PVD, CVD, dipping, spraying, and sol-gel.

17. The method for producing a stimulation electrode according to claim 1, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is formed by depositing a metallic layer comprising at least one metal selected from the group consisting of titanium, niobium, tantalum, zirconium, aluminum, and silicon, and the deposited metallic layer is subsequently subjected to a thermal oxidation, electrochemical oxidation, chemical oxidation, or oxynitridation process.

18. The method for producing a stimulation electrode according to claim 1, wherein the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) is made of titanium, and the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is formed by at least partially oxidizing the titanium electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) to titanium oxide by thermal or electrochemical oxidation.

19. The method for producing a stimulation electrode according to claim 1, wherein the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) is made of tantalum, and the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is formed by at least partially oxidizing the tantalum electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g) to tantalum oxide by thermal or electrochemical oxidation.

20. The method for producing a stimulation electrode according to claim 3, wherein the electrically conducting layer is made of titanium nitride and the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is formed by at least partially oxidizing the titanium nitride electrically conducting layer (4a, 4d, 4e, 4f, 4g) to titanium oxide by thermal or electrochemical oxidation, and wherein the oxidation includes at least a portion of a layer thickness of the titanium nitride electrically conducting layer (4d, 4e, 4f, 4g).

21. The method for producing a stimulation electrode according to claim 9, wherein the electrically conducting layer is made of titanium nitride and the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is formed by at least partially oxidizing the titanium nitride electrically conducting layer (4a, 4d, 4e, 4f, 4g) to titanium oxide by thermal or electrochemical oxidation, and wherein the oxidation includes at least a portion of a layer thickness of the titanium nitride electrically conducting layer (4d, 4e, 4f, 4g).

22. The method according to claim 17, wherein the thermal oxidation takes place by a laser.

23. The method according to claim 18, wherein the thermal oxidation takes place by a laser.

24. The method according to claim 19, wherein the thermal oxidation takes place by a laser.

25. The method according to claim 20, wherein the thermal oxidation takes place by a laser.

26. The method according to claim 21, wherein the thermal oxidation takes place by a laser.

27. The method according to claim 16, wherein the ceramic layer (3, 3a, 3b, 3c, 3d, 3e, 3f, 3g) is first formed on an entire coated or uncoated surface of the electrode base member (2, 2a, 2b, 2c, 2d, 2e, 2f, 2g), and is then partially removed again by etching.

28. The stimulation electrode according to claim 1, which is in a form of a human implant.

29. The stimulation electrode according to claim 28, wherein the human implant is a cardiac pacemaker electrode or a neuro-stimulation electrode.